

Application No. 10/789,498  
Amendment filed concurrently with RCE

Customer No. 01933

### R E M A R K S

Reconsideration of this application, as amended, is respectfully requested.

### THE CLAIMS

Independent claim 1 and corresponding method claim 6 have been amended to clarify the feature of the present invention whereby the detected signal, which prompts the increasing of the adapter voltage by the predetermined amount, is produced when the charging current decreases to less than a set current value due to a drastic decrease of the charging current. And it is noted that "drastic decrease" is defined in the specification at page 12, lines 11-15 as the decrease in the charging current  $I_c$  that occurs when the voltage difference  $V_{ADP} - V_{BATT}$  is lower than the necessary minimum voltage  $\Delta V$  (due to the gradual decreasing of the adapter voltage  $V_{ADP}$ ).

In addition, independent claim 1 and corresponding method claim 6 have been amended to clarify the feature of the present invention whereby the voltage control circuit repeats operations comprising gradually lowering the adapter voltage and increasing, in response to the detected signal, the adapter voltage by a predetermined voltage, so that the AC adapter carries out a constant voltage charging with a necessary minimum voltage

Application No. 10/789,498  
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Customer No. 01933

difference which is a potential difference between the adapter voltage the a battery voltage of the secondary battery on a constant current charging, as supported by the disclosure in the specification at page 13, lines 10-14.

No new matter has been added, and it is respectfully requested that the amendments to claims 1 and 6 be approved and entered.

#### THE PRIOR ART REJECTION

Claims 1, 3, 4, 6, and 7 were rejected under 35 USC 103 as being obvious in view of the combination of USP 5,442,274 ("Tamai") and USP 5,654,622 ("Toya et al"); and claims 2 and 5 were rejected under 35 USC 103 as being obvious in view of the combination of Tamai, Toya et al and USP 6,246,890 ("Sato et al").

According to the present invention as recited in amended independent claim 1 and corresponding method claim 6, when the charging current decreases to less than a set current value due to a drastic decrease of the charging current to produce a detected signal, operations of gradually lowering the adapter voltage and increasing, in response to the detected signal, the adapter voltage by a predetermined voltage are repeated, so that the AC adapter carries out a constant voltage charging with a

Application No. 10/789,498  
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Customer No. 01933

necessary minimum voltage difference which is a potential difference between the adapter voltage and a battery voltage of the secondary battery on a constant current charging.

That is, in the AC adapter 10A according to the present invention, a  $-\Delta I$  detection circuit 45 detects that the charging current  $I_c$  decreases to less than a set current value due to a drastic decrease of the charging current  $I_c$  to produce a detected signal (page 12, lines 15-18). A voltage control circuit 42A then operates by gradually lowering the adapter voltage  $V_{ADP}$  and increasing, in response to the detected signal, the adapter voltage  $V_{ADP}$  by a predetermined voltage, as shown in Fig. 7. And the AC adapter 10A carries out a constant voltage charging with a necessary minimum voltage difference  $\Delta V$  which is a potential difference  $V_{ADP} - V_{BATT}$  between the adapter voltage  $V_{ADP}$  and a battery voltage  $V_{BATT}$  of a secondary battery 21 on a constant current charging (page 13, lines 10-14 and Fig. 7). As a result, it is possible to lower generation of heat in the charging control element Q within the main body 20 (page 13, lines 14-15). It is thereby possible to decrease power consumption in the AC adapter 10A.

It is respectfully submitted that none of the cited references discloses, teaches or suggests the combination of the detection means and the voltage control circuit of the claimed

Application No. 10/789,498  
Amendment filed concurrently with RCE

Customer No. 01933

present invention, whereby an AC adapter carries out a constant voltage charging with a necessary minimum voltage difference which is a potential difference between the adapter voltage and a battery voltage of the secondary battery on a constant current charging.

As recognized by the Examiner, Fig. 9 of Tamai shows a power supply 81, a switching section 85, primary and secondary windings of a transformer 86, a rectifying and smoothing circuit 88, a constant voltage charging circuit 96, a constant current charging circuit 97, a photocoupler 90, and a pulse width modulation control circuit 89. And as recognized by the Examiner, Tamai discloses detecting when the charging current drops below a set value.

On page 6 of the Office Action, the Examiner asserts that column 8, line 1-8 of Tamai disclose gradually lowering the adapter voltage. However, this portion of Tamai merely discloses that the reference voltage is reduced from E1 to E2, thereby determining the first prescribed voltage V1 or the second prescribed voltage V2. And as explained at the bottom of column 6 and top of column 7 of Tamai, the battery is charged to the voltage V1, at which point constant current charging is stopped, and charging is switched to pulse charging, in which the battery voltage is limited to the voltage V1. After a given

Application No. 10/789,498  
Amendment filed concurrently with RCE

Customer No. 01933

interval, constant voltage charging is carried out at the second prescribed voltage V2, which is slightly lower than V1.

It is respectfully submitted, therefore, that switching reference voltages in the constant voltage charging circuit 96 of Tamai does not correspond to gradually lowering the adapter voltage in the manner of the claimed present invention. And it is respectfully submitted that column 7, lines 61-64 of Tamai (referred to by the Examiner on page 4 of the Office Action), clearly does not disclose gradually lowering the adapter voltage in the manner of the claimed present invention.

On page 3 of the Office Action, the Examiner contends that Toya et al discloses a voltage control circuit that gradually lowers the adapter voltage and increases the adapter voltage by a predetermined voltage in response to a detected signal at column 2, lines 48-62, thereof.

It is respectfully submitted, however, that the cited section of Toya et al merely discloses first charging a battery by constant current charging, and then charging the battery until the battery voltage becomes higher than a first protecting voltage. In this state, according to Toya et al, the protecting circuit (which interrupts the charging when the battery voltages reaches the first protecting voltage) is prevented from operating by switching changing the first protecting voltage of the

Application No. 10/789,498  
Amendment filed concurrently with RCE

Customer No. 01933

protecting circuit to a second protecting voltage that is higher than the first protecting voltage.

Thus, it is respectfully submitted that the cited portion of Toya et al does not disclose, teach, or suggest the feature of the claimed present invention whereby the voltage control circuit gradually lowers the adapter voltage and increases the adapter voltage by a predetermined voltage in response to a detected signal.

In addition, the Examiner contends on page 6 of the Office Action that, since the protection circuit of Toya et al is configured not to cause an interruption in the charging of the battery, the adapter voltage will be gradually lowered according to Toya et al.

As recognized by the Examiner, Toya et al discloses at column 4, lines 8-17 thereof that the secondary battery is rapidly charged without interruption of the charging caused by the operation of the protection circuit. However, according to the invention of Toya et al, by repeating the constant voltage charging with the first voltage and the constant voltage charging with the second voltage, the adapter voltage is abruptly changed between the first voltage and the second voltage in a manner such as a square wave. Accordingly, it is respectfully submitted that

Application No. 10/789,498  
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Customer No. 01933

Toya et al does not disclose, teach, or suggest that the adapter voltage is gradually lowered.

Still further, the Examiner has referred to Fig. 6 of Toya et al with respect to increasing the adapter voltage when a charging current flowing through the secondary battery is less than a set current value.

It is respectfully pointed out, however, that Fig. 6 of Toya et al is a graph showing the battery voltage of a secondary battery and the charging current, but does not show the adapter voltage.

Sato et al, moreover, has merely been cited for the disclosure of a portable telephone set.

In view of the foregoing, it is respectfully submitted that the present invention as recited in amended independent claims 1 and 6, and claims 2-5 and 7 respectively depending therefrom, clearly patentably distinguishes over Tamai, Toya et al and Sato et al, taken in any combination under 35 USC 103.

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Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

Application No. 10/789,498  
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Customer No. 01933

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned for prompt action.

Respectfully submitted,



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